

Fluvial and oceanographic influences on suspended sediment dispersal in the Magdalena River Estuary

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ABSTRACT

The Magdalena River is the main contributor of fresh water and sediment to the Caribbean Sea. Hydrological inputs from the Magdalena River are 10,287 and 4068 m³ s⁻¹ at high and low flows, respectively. Sediment delivery from the Magdalena River is among the largest in the world, with 142×10^6 t yr⁻¹ of transported suspended matter. We used MODIS images to develop a regional model and assess the spatial and temporal

variability of suspended sediment concentration at the mouth of the Magdalena River, map the extent of the turbidity plume using its morphometric properties, and identify the main fluvial and oceanographic factors associated with plume variability. We analyzed monthly average suspended sediment concentration data for the period 2003–2017. MODIS images were calibrated with in situ measurements of suspended sediment concentrations

in surface waters of the study area. A finite mixing model was used to identify turbidity thresholds and define areas within the plume. Calculated suspended sediment concentrations indicate high turbidity in the Magdalena River mouth (178.6 ± 78.7 mg L⁻¹), values that are of the same order of magnitude as those measured in the Yangtze, Huang He and Amazon River mouths.

Calculated plume areas (diffuse, solid and mixing) and their shapes suggest that the Magdalena River plume has a limited area, related to conditions such as wind speed and direction, streamflow, and sediment transport. Calculated areas and shapes demonstrate the ability to generate a near-field area, which indicates the presence of a clear convergence front. The data also

emphasize the importance of sediment transport from the Magdalena River to the Caribbean Sea. Such fluvial transport is important in the biogeochemistry of estuarine systems, especially in turbid estuaries, where there is marked variability in the distribution of sediment in surface waters.

Keywords: Remote sensing, Sediment transport, Turbid plume, MODIS, Magdalena River.